




Resistant Materials

February Half Term Revision

Checklist

<u>TOPIC</u>		<u>UNDERSTANDING</u>		
		RED ☹	AMBER ☺	GREEN ☺
MATERIALS PROCESSING AND FORMING	SAND CASTING			
	DRILLING			
	TURNING WOOD AND METAL			
	BLOW MOULDING			
	INJECTION MOULDING			
	VACUUM FORMING			
	EXTRUSION			
	WOOD LAMINATING			



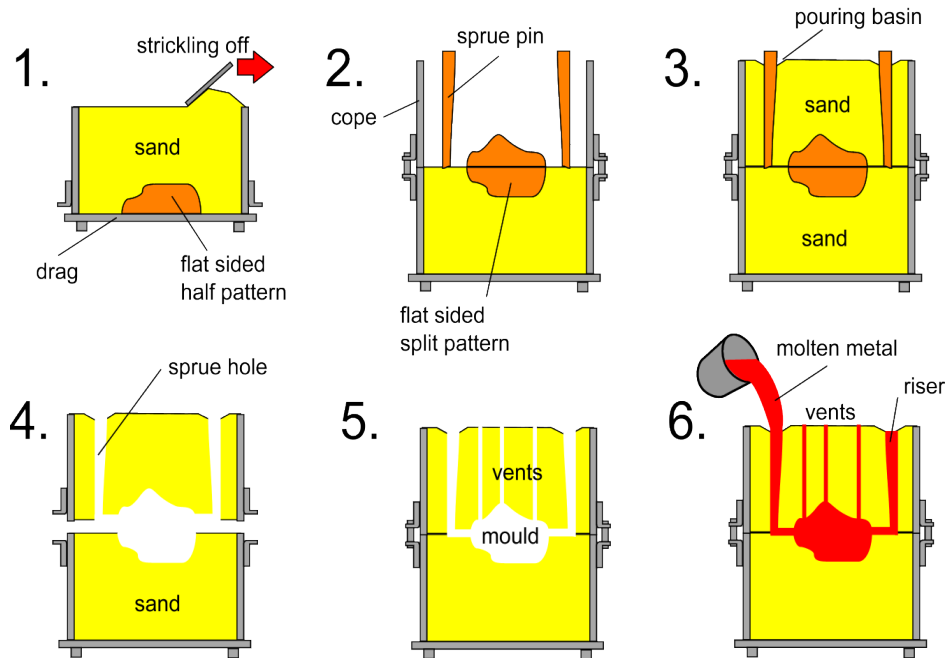
Materials Processing and Forming

3.2

Sand Casting



Sand Casting suitable for steel or aluminium



Metal moulding process

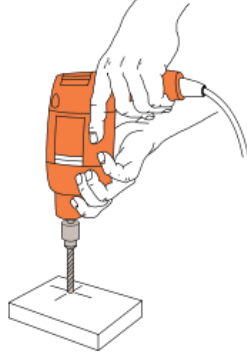
where sand is used as the mould material. Produced in specialised factories called 'foundries'. **Over 70% of all metal castings are produced using sand casting.** Clay is used to bind the sand together when casting.

Why do you think sand is used with metal casting?



Examples

Solid metal structures such as machine parts, car engine parts, etc...

Drilling



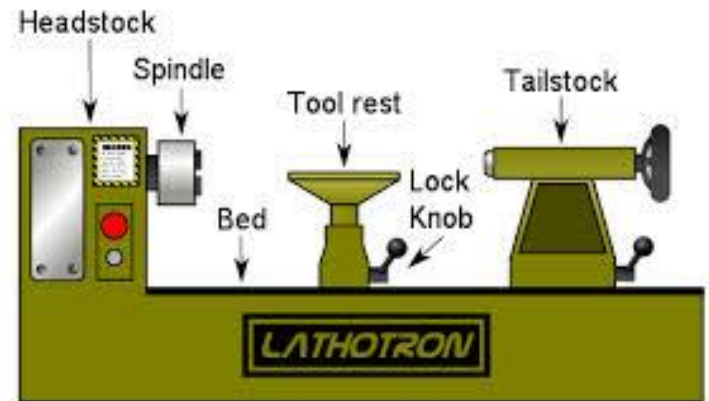
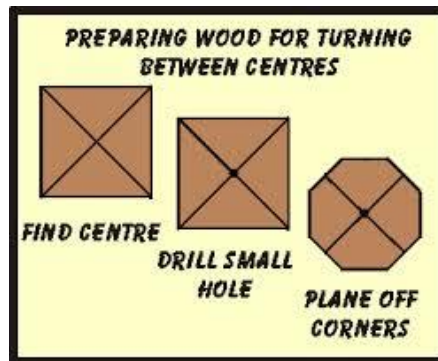
- A wasting process used for **boring holes through a variety of materials.**
- Types of drills; **pillar drill, hand drill, cordless drill.**
- Safety; wear goggles, aprons and tuck away loose clothing.

Drill	Adv	Disadv
	<ul style="list-style-type: none">.Can be used continuously..Chuck can be removed for larger drill bits..Speed can be variable.	<ul style="list-style-type: none">.Fixed in one position..Can be dangerous.
	<ul style="list-style-type: none">.Portable	<ul style="list-style-type: none">.You need to provide the power..Only holds drill bits up to 10mm.
	<ul style="list-style-type: none">.Portable..Generally has a variable speed..Has a reverse direction..Can be used to put in and take out screws.	<ul style="list-style-type: none">.Power limited to battery size..Charging batteries takes time..Will only hold drill bits up to 10mm in diameter.

Turning Wood

- This allows circular wooden products to be made, such as fruit bowls and stair spindles.
- There are **two ways** – using a **faceplate** or **between the centres**. You **cannot** do **both** at the same time.
- You **must take care**. The **distance between the object** being turned and the **tool rest must be small so** that the **tool does not catch** and be **pulled from your hands**.
- It is **a wasting process**.
- You **must prepare the wood first** before it is turned.

How wood should be prepared before turning between centre.



Faceplate



Faceplates can be added to the 'outside' spindle. A wooden blank can then be added to turn into fruit bowls, etc.


Turning Wood

ADV

- Waste reused for animal bedding.
- One-off shapes and products can be made.
- Small off-cuts from the workshop can be turned into other products.

Turning Metal

- Same set up as wood turning except there is no outside spindle.
- Two main turning processes – facing and parallel turning.
- Others are – taper turning, drilling, parting, knurling.

Operation		Description
FACING		Tool at right angle at end of work.
PARALLEL TURNING		Tool moves horizontally to remove material.
TAPER TURNING		Tool at an angle to produce a taper.
PARTING		Narrow tool used to trim or part work.
DRILLING		Drill bit in tailstock to drill horizontally into work.
KNURLING		Hardened steel wheel pressed into work to create a diamond pattern.

Turning Metal

ADV

- Chuck holds a variety of sizes and lengths.
- Very accurate sizing possible.
- Drilling and taping can be done.
- Accurate drilling of holes.
- Cylindrical items that have been cast can be turned to create a smooth finish.
- Bigger tubes can be held using the outside of the three-jaw chuck.

Disadvantages of Turning (Wood and Metal)

DISADV

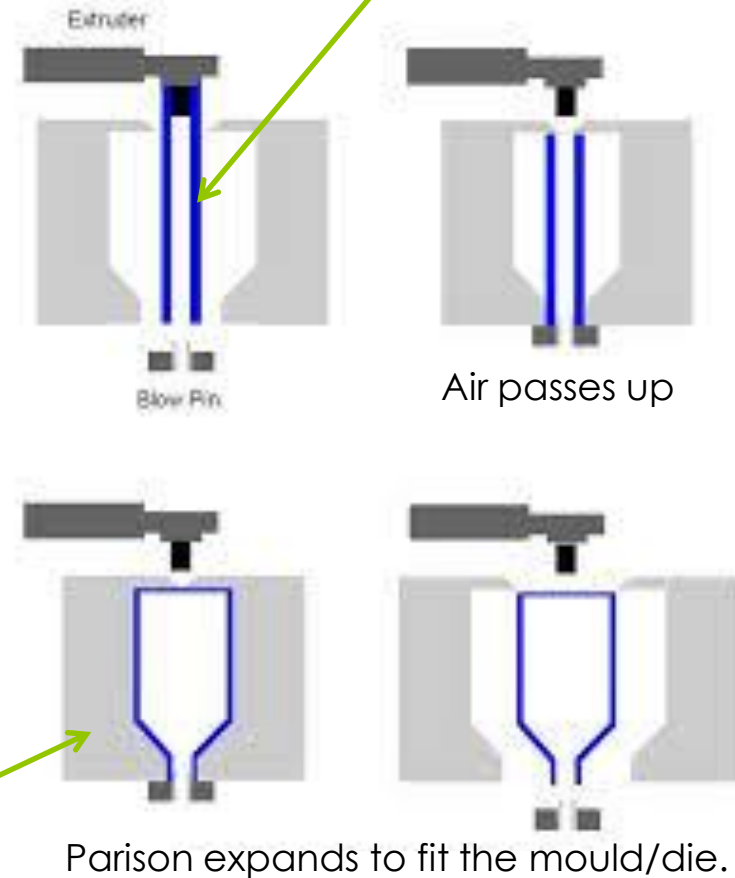
- Long objects can flex if not supported properly.
- Once the object is removed it's difficult to put back on in the centre.
- Incorrect speeds or tool feeds can damage the work and the tools.
- Tools need regular sharpening.
- Workpiece and tools get hot.
- Difficult to make exact copies by hand.
- Tools can catch on edges which is dangerous.

Blow Moulding

- Used to make **strong, hollow plastic products**.
- Examples of products – **bleach, shampoo, disinfectant and fizzy drinks bottles and water butts**.
- Starts with a **PARISON** (a hosepipe-like piece of plastic with a hole in one end that air can pass through).
- The mould (**DIE**) traps the parison in place, **air is passed through it and the parison expands to the shape of the mould**.
- The parison is made by the process of **extrusion**.

DIE

PARISON



Blow Moulding



There is a second, simpler, form of blow moulding that is similar to vacuum forming. Plastic is clamped and heated and then air is blown up into the plastic to make it expand like a balloon. Once the plastic is cool it remains in the dome shape.

ADV

- **Very cheap unit costs.**
- **Highly automated** process.
- **Not very labour intensive.**
- **Can run for 24 hours a day** – ideal for high volume production.
- **Little finishing needed** once mould is made.

DISADV

- **Initial costs of machines and tools is very high.**
- **Not suitable for small production runs.**
- **Sometimes a seam is left around the product** where the mould closes.

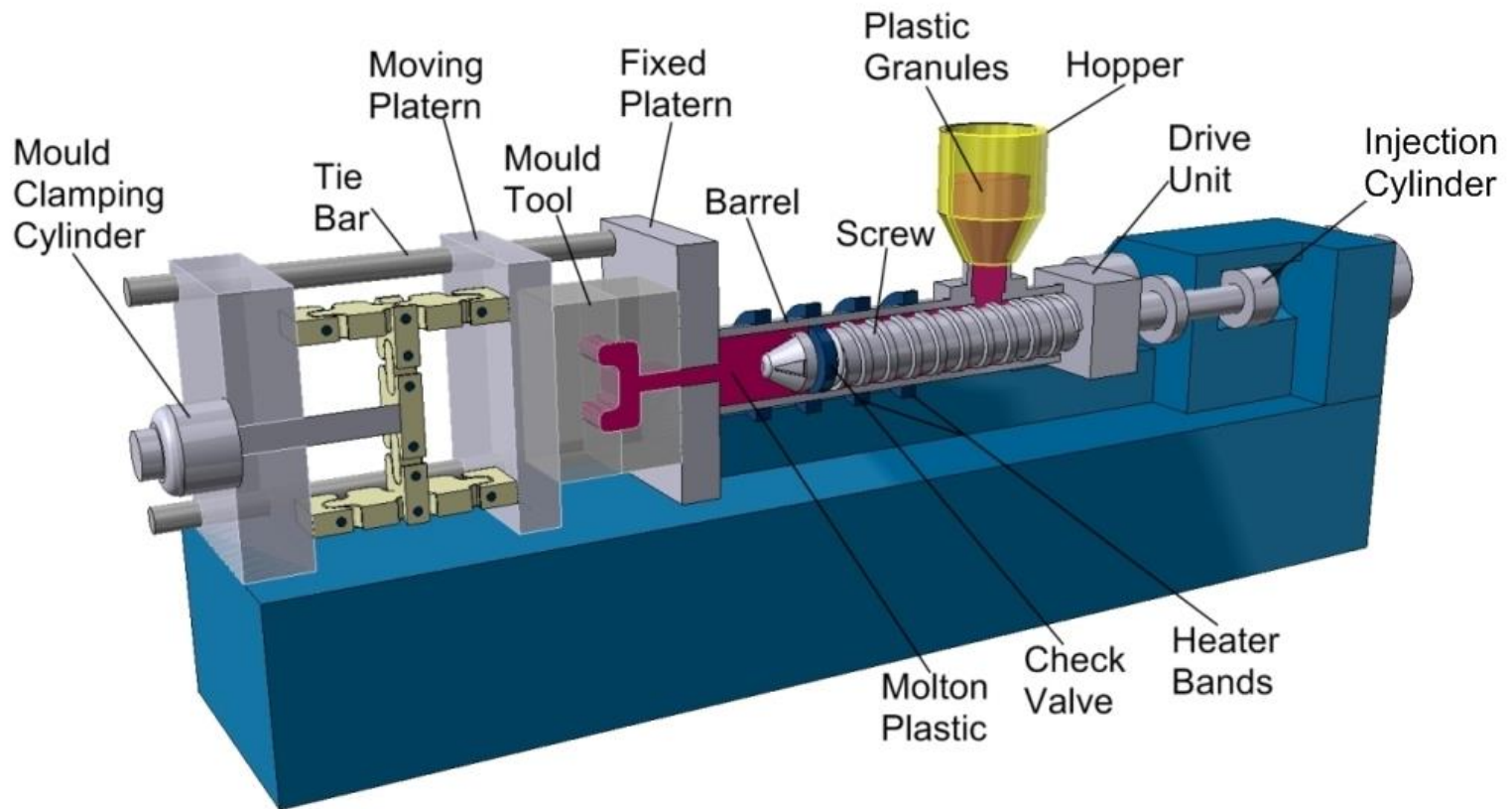
Injection Moulding

- Highly automated process.
- **Produces** – washing-up bowls, buckets and cases for household electrical goods.
- Mostly used on thermoplastics but some thermosetting plastics can be used.
- Machine is made up of – a hopper, a screw and injector unit, a heating element and a mould.

How it works

1. **Hopper** full of **plastic granules** feeds a rotating **screw** mechanism.
2. The plastic granules move along the screw and are **heated at the same time**.
3. As the granules are heated **they begin to melt (plasticise)**.
4. Once melted, the **screw continues to push the plastic along** and into the barrel.
5. The **screw** continues to turn and **pushes the plastic** from the barrel **into the mould**.
6. **The plastic is left to cool and set in the mould**.
7. **Once** the plastic is **cool enough**, the mould splits open and **the product is ejected**.
8. **The mould then closes and** the whole process **starts again**.

Injection Moulding



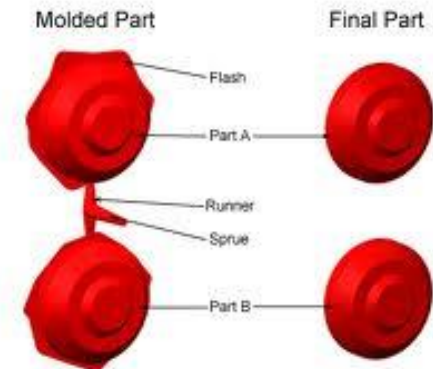
Injection Moulding

ADV

- Can operate 24 hours a day.
- Can make different-coloured products.
- Inserts, such as screwdriver blades, can be moulded directly into handles.
- Several smaller items can be manufactured in a single mould.
- Suitable for high-volume continuous production.
- High level of accuracy.
- Identical components each time.
- Little or no extra finish required.
- Unit cost low compared with initial set-up costs.

DISADV

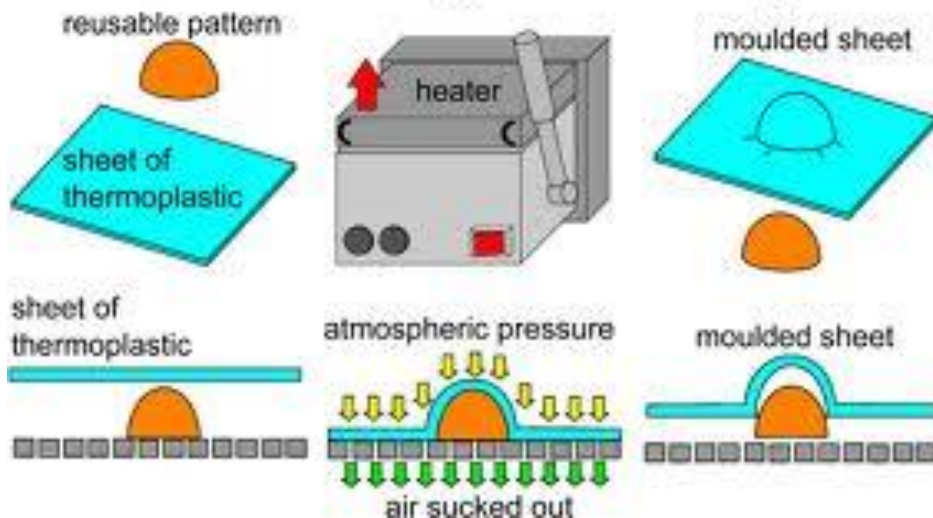
- Initial machine and mould costs high.
- Some flashing may have to be removed.
- Sprue pins need to be cut off.



Vacuum Forming

- **Produces** – easter egg containers, yoghurt pots, trays, dishes and masks.
- **Materials** – thermoplastics, such as polythene, PVC, ABS and acrylic.

Vacuum Forming of thermoplastic



Mould design is crucial. It must:

- Have draft angles on all vertical surfaces.



- Have rounded off sharp corners.
- Have vent holes to make sure the air passes through.
- Have rounded off internal edges.

Vacuum Forming

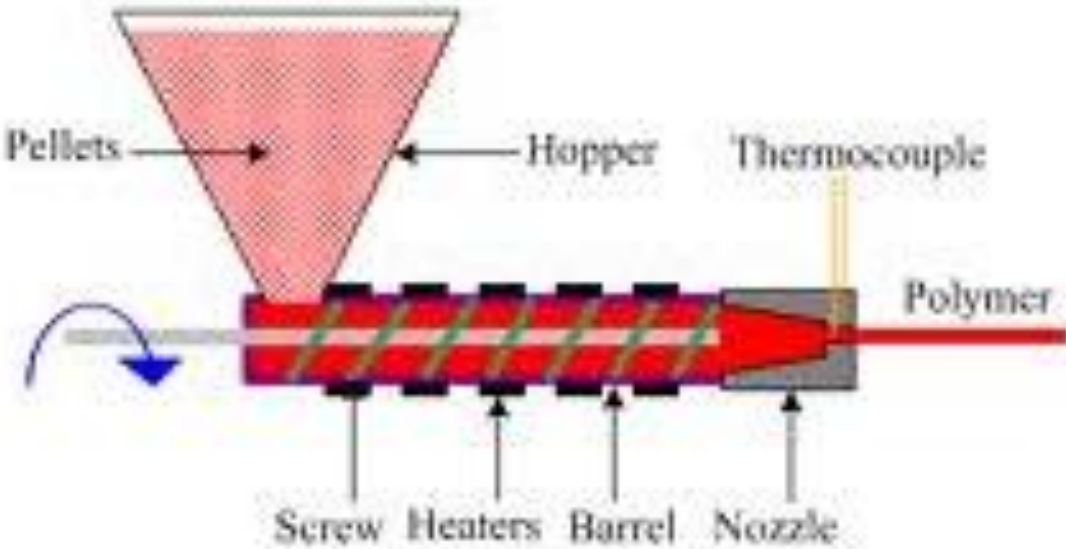
<u>ADV</u>	<u>DISADV</u>
<ul style="list-style-type: none">• Lightweight, hollow products can be made.• Relatively cheap moulds made from MDF can be made in schools for a one-off item.• Surface textures can be moulded into products.	<ul style="list-style-type: none">• Thermoplastic sometimes thins too much and may burst or pop.• Webs sometimes form between items, meaning product cannot be used.• Products need to be trimmed and cut out once formed.

Extrusion

- Used for making products that have a regular, fixed cross-sectional profile.
- **Products** – rain water guttering and copper pipes.
- **Materials** – metals, polymers, concrete and foodstuffs.

<u>ADV</u>	<u>DISADV</u>
<ul style="list-style-type: none">• Continuous lengths can be made.• Complex profiles can be achieved.• Seamless tubes produced.• Small production runs completed with relative ease.• Excellent surface finish to plastics.• Very high tolerances can be achieved (excellent accuracy).	<ul style="list-style-type: none">• Initial set-up costs of machinery and upkeep are high.• Die costs can be very high.• Hot extrusion of metals (i.e. steel) can leave an oxidised surface finish.

Extrusion



Extrusion Plastic

- Materials – different plastics are used.
- Products – plumbing pipes, rainwater guttering, curtain tracks, uPVC window-frame sections.
- Uses – As above, but also can be **used to coat products**, such as **copper wire**. The bare wire can be extrusion coated with either blue or brown wire to show whether the wire is live or neutral, for example.

Extrusion Metal

- Can be **hot** or **cold extrusion**.
- **Materials** – **aluminium and copper** mostly in **cold extrusion**.
- **Cold** extrusion leaves **no surface oxidation** and has a **better surface finish**.
- Starts with a **billet** – a **large lump of metal**.
- The **billet is heated in an oven** before being **placed in the extrusion machine**.
 - A ram **then pushes** the material **through the die**.
- **Products** – **seamless tubes, reinforcing sections** into uPVC windows (increase strength) and **heat sinks**.

Wood Laminating



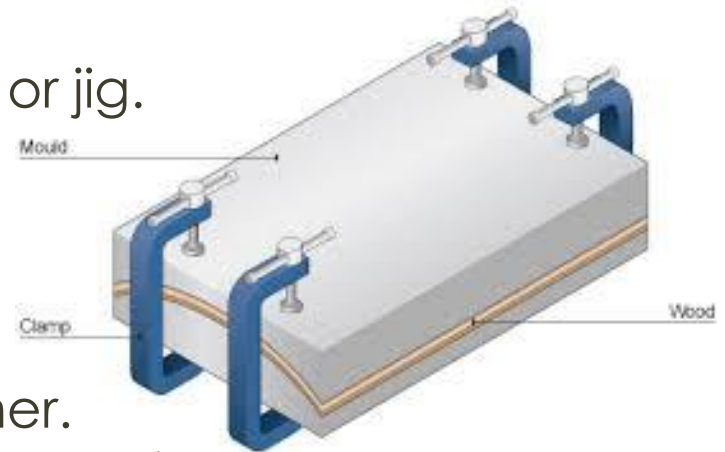
- Is **building up thin layers** of wood **around a former** to produce the **desired shape or curve**.
- **Materials** – thin veneers or skin ply (cut to shape, ensuring the grain is running in the same direction).
- Layers **glued together using an adhesive** (PVA or Cascamite).
- **Laminated timber** can be used for **large sectional beams** in structures, such as **roof beams, floor beams or joists**.

Wood Laminating

1. Layers are glued together.
2. Layers then trapped in a former or jig.
3. Held together with clamps.
4. Item left for glue to dry.

For larger items.

1. Layers are glued together.
2. Layers are placed over the former.
3. The layers and the former are placed in a vacuum bag.
4. The vacuum bag is sealed and all the air is sucked out.
5. Atmospheric pressure forces the layers together and around the former until the glue (adhesive) sets.



Wood Laminating

<u>ADV</u>	<u>DISADV</u>
<ul style="list-style-type: none">• Complex shapes can be made.• Large sections can be built up to improve strength.• Several small products can be laminated at the same time.	<ul style="list-style-type: none">• Requires a former to made, even for a one-off.• Special adhesives need to be used if the finished product is going to be used outside.• Must be left for up to 24 hours for adhesives to dry.